

IPCEI on Advanced Semiconductor Technologies - Central narrative

Annex: Technology Fields

AI Chips and Accelerators

The development of AI chips and accelerators “Made in Europe” boasts a tremendous potential to differentiate the local semiconductor and downstream industries from competitors worldwide as well as being beneficial to society at the same time. In addressing novel technologies within an IPCEI AST, existing dependencies on third countries (e.g. USA and China) can be reduced and new ones can be avoided. While the EU faces fierce competition with US standard GPU architectures at small technology nodes, various other chip architectures with potential applications in AI exist in Europe at worldwide state of the art level and close to first industrial deployment.

The focus should lie on novel technologies encompassing energy-efficient and secure solutions creating new market applications, e.g. in data centres and automation. For instance, promising developments exist in edge-AI computing enabled by compute-in-memory technologies and the integration of GaN/SiC-based devices. Thereby, it is important to co-design hardware and software in close cooperation with applicants to promote the entire European ecosystem, supporting start-ups and fostering collaboration across the value chain.

Chiplets and Heterogenous Integration / Advanced packaging

Chiplets and heterogenous integration generate a great opportunity to increase security of Europe's supply and resilience, have good success prospects and a decent integration into the European semiconductor ecosystem. However, it is necessary to co-develop Advanced Packaging capabilities in Europe. Not including this field into the IPCEI AST risks worsening dependencies on third countries (Asia), reduced competitiveness in the semiconductor industry and downstream industries.

Addressing Chiplets and Heterogeneous Integration as well as Advanced Packaging in the IPCEI AST would help to de-fragmentize the current developments and bring them into first industrial deployment in Europe. This would also create advancements in automation, testing and standardization processes, which are prerequisites for the establishment of stable production capacities. Thereby, the focus should be towards broader applications, which also makes close collaboration with applicants indispensable.

Disruptive Sensors for Autonomy

Europe has a strong position in the field of developing and producing sensors for a vast number of applications. Thus, this situation can be used to create a unique selling point for Europe and develop sensor fusion systems acting purely autonomous within the IPCEI AST. This encompasses the co-development and integration of AI technologies and addressing energy efficiency, low latency as well as high security and trustworthiness at the same time. Thereby, a holistic, collaborative approach to strengthen Europe's semiconductor ecosystem and secure its technological future is absolutely necessary.

Photonic Integrated Circuits

At the moment, Photonic Integrated Circuits (PIC) have a strong European base in design and materials, but critical gaps in manufacturing and a reliance on foreign foundries. Although this technology field is highly innovative with a potential to be disruptive, the current value chain in Europe is strongly fragmented. In addressing the development of PIC in an IPCEI AST, future

geopolitical dependencies can be reduced. Thereby, the focus should rely on strengthening the ecosystem with conception, packaging and system integration following a holistic approach along the entire value chain to establish a competitive position.

Power Electronics and Disruptive Energy Saving Solutions

When it comes to power electronics, the focus should be on disruptive developments of GaN/SiC-based devices, which have the potential to be included into the IPCEI AST. The most promising opportunities are addressing new device architectures and processes, full stack design for new product development (from transistor to system design), and 300 mm wafer production for GaN and SiC. This should result in being technological competitive with Si and other global players, system solutions for customers, technology that can scale and cover a wide range (w.r.t. voltage range) of applications, and ecosystem of power semiconductor players within the full stack to drive product development and to offer customers full solution low cost products. One additional field that could constitute a promising topic to be integrated to the IPCEI AST, for the developments that are IPCEI-ready in terms of TRLs, is UWB materials. These developments could contribute to achieving better performance, especially in the context of the increasing uptake of AI.

This will also help to maintain security in electric infrastructure and to not miss future market opportunities.

Secure Communication

Although the overall communications field (RF/Microwave and 5G/6G technologies) has seen substantial aid (e.g. under previous IPCEIs) and is now in a state, where mature technologies require incremental developments, this field has a strategic dimension, especially when it comes to security. Thus, the IPCEI AST shall address the development of specifically security related communication technologies. They are crucial for AI and data reliability and encompass, among others, 6G integration, quantum-safe and laser communication as well as advanced photonics but also disruptive RF/microwave developments that are decidedly different from developments funded under previous IPCEIs. Thereby, hardware/software co-design and involvement of the entire value chain are necessary to accelerate innovation and ensure European leadership in this critical area.

Enabling Technologies

The semiconductor value chain encompasses much more than just the design and front- and back-end manufacturing of the chips themselves. Essential steps such as EDA, manufacturing and testing equipment, as well as inputs (e.g. materials, wafers) are just as important within the semiconductor supply chain. As these steps are often capital-intensive, support is needed to scale these technologies. Europe should focus its efforts on fields where it can become indispensable within global supply chains. In the context of enabling technologies this means areas such as equipment and materials and design competence including tools. Additionally, the IPCEI should also focus on strengthening the ecosystem as a whole, including SMEs. The IPCEI can also contribute to EU-wide standard-setting, lowering the entry conditions for SMEs. Using the IPCEI to localize equipment suppliers in the EU can fill the gaps in our value chains, which will allow for close feedback loops with users and faster innovation cycles.